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Signed

Dated 19 March 2004

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Patents Form 1/77

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The Patent Office

19APR03 E801494-1 C68900
P01/7700 0.00-0309055.2

17 APR 2003

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
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South Wales
NP10 8QQ

1. Your reference — P-UK-PR 1116

2. Patent application number *(The Patent Office will fill in this part)* — 0309055.2

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

BLACK & DECKER INC.
DRUMMOND PLAZA OFFICE PARK
1423 KIRKWOOD HIGHWAY
NEWARK, DELAWARE, USA

Patents ADP number *(if you know it)* — 341214004

If the applicant is a corporate body, give the country/state of its incorporation — DELAWARE, USA

4. Title of the invention

ROTARY HAMMER

5. Name of your agent *(if you have one)* — IAN BELL

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

PATENT DEPT.
BLACK & DECKER EUROPE
210 BATH RD.
SLOUGH, SL1 3YD

Patents ADP number *(if you know it)* — 7590565001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
\		

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*
\	

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	5
Claim *(s)*	1
Abstract	1
Drawing *(s)*	16 +16

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	0
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	0

11. I/We request the grant of a patent on the basis of this application.

Signature I S Bell Date 15/04/03

12. Name and daytime telephone number of person to contact in the United Kingdom 01753 500788.

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b) *Write your answers in capital letters using black ink or you may type them.*

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e) *Once you have filled in the form you must remember to sign and date it.*

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ROTARY HAMMER

Present invention relates to rotary hammers and in particular, to rotary hammers incorporating an overload clutch arrangement.

Rotary hammers normally have a housing and a hollow cylindrical spindle mounted in the housing. The spindle allows insertion of the shank of the tool or bit, for example a drill bit or a chisel bit, into the front end thereof so that is retained in the front end of the spindle with a degree of axial movement. The spindle may be a single cylindrical part or may be made of two or more coaxial cylindrical parts, which together form the hammer spindle. For example, a front part of the spindle may be formed as a separate tool holder body for retaining the tool or bit.

Such hammers are provided with an impact mechanism which converts the rotational drive from an electric motor to a reciprocating drive for driving a piston, which may be a hollow piston, to reciprocate within the spindle. The piston reciprocatingly drives a ram by means of a closed air cushion located between the piston and the ram. The impact from the ram is transmitted to the tool or bit of the hammer, optionally via a beatpiece.

Rotary hammers can be employed in combination impact and drilling mode, and also in some cases in a drilling mode only, in which the spindle, borrow forward most part of the spindle, and hence the bit inserted therein will be caused to rotate. In combination impact and drilling mode, the bit will be caused to rotate at the same time as the bit receives a repeated impact. A rotary drive mechanism transmits the rotary drive from the electric motor to the spindle to cause the spindle, or a forward most part thereof, to rotate.

Rotary hammers are known to have overload clutches in the drive train which transmit rotary drive from the motor to the spindle, or the forward most part of the spindle. Such overload clutches are designed to transmit rotary drive when the transmitted drive torque is below a predetermined threshold and to slip when the transmitted drive torque exceeds threshold. During rotary hammering or drilling, and working on materials of none uniform hardness, for example aggregate or steel reinforced concrete, the bit becomes stuck, which causes the torque transmitted via the rotary drive train to increase and causes the hammer housing inturn to rotate against grip of the user. The torque can increase rapidly and in some cases the user can lose control of the hammer. The use of an overload clutch, can reduce the risk of this occurring, by ensuring that the clutch slips and rotary drive to the bit is interrupted at a torque threshold below that where a user is likely to lose control the hammer. Accordingly, the clutch must slip reliably at a predetermined torque throughout the lifetime of the hammer, even after sustained use of the hammer.

Relevant prior art is DE2522446, DE3828309, DE4216808 and EP0552328.

It is an object of the present invention to provide a clutch with improved performance.

Accordingly there is provided a hammer comprising a spindle capable of being rotatingly driven by a motor via a drive chain, the drive chain comprising an overload spindle clutch which is capable of slipping when a torque which is greater than a predetermined amount is applied to it wherein the clutch comprises a sliding hub which is slidably mounted on the spindle having at least one spline formed along its inner surface which engages with at

least one corresponding trough formed along the length of the spindle characterised in that the trough and the splines are correspondingly tapered along their length.

Preferably, the end of the spline adjacent a stop mechanism, which prevents the sliding hub from travelling rearward a ly more than a predetermined position due to a biasing force, has been tapered at an angle relative to the longitudinal axis of the sliding hub. This can enable a rubber O-ring to be mounted adjacent the end of the spline to prevent the sliding hub from travelling rearwardly more than a predetermined position due to a biasing force.

An embodiment of the invention will now be described with reference to the following six drawings of which:-

Figures 1A to 1F show the existing design of sliding hub located around the spindle;
Figures 2A to 2F show the new design of sliding hub located around the spindle;
Figure 3A to 3F show a design drawing of the old design of sliding hub;
Figure 4A to 4I show a design drawing of the new design of sliding hub;
Figure 5A to 5D shows a design drawing of the old design of spindle; and
Figure 6A to 6E shows a design drawing of the new design of spindle.

Referring to figures 1A to 1F, which show an old design of parts of the spindle clutch, a sliding hub 2 is mounted on a spindle 4 of the hammer. A helical spring 6 is wrapped around the sliding hub 2 and biases the sliding hub rearwardly. A circlip 8 prevents the sliding hub 2 from travelling further rearwardly due to the biasing force of the spring 6. Teeth 10 are formed around one end of the sliding hub 2. Formed in the spindle 4 are two elongate troughs 12 which will run in a direction parallel to the longitudinal axis 14 of the

spindle 4. These troughs 12 can be best seen in Figure 5 which is a design drawing of the old design of spindle 4. The troughs have a uniform cross-section along the length of the troughs, the sides of the troughs running parallel to each other.

Formed on the inner surface of the sliding hub are two splines 16 which correspond to the elongate troughs 12 in the spindle 4. When the sliding hub 2 is mounted on the spindle 4, the splines 16 locate within the elongate troughs 12. The sliding hub 2 is able to slide along the length of the spindle 4 with the splines 16 sliding within the troughs 12. Though the splines 16 allow the sliding movement of the sliding hub, they prevent the sliding hub s from rotating around the spindle 4. This enables a rotation force to be transferred from the sliding hub to the spindle due to the splines located within the elongate troughs.

The cross-section of the splines 16 is uniform along their length, the sides of the splines 16 being roughly parallel along the length of the splines. The end 20 of the splines 16 adjacent the circlip 8 is perpendicular 18 to the longitudinal axis 14 of the sliding hub 2 and spindle 4 as best seen in Figure 3.

Some problems have been experienced with the sliding hub 2 sliding back. Therefore, a design change has been made to the spindle 4 and sliding hub 2 to introduce some friction into the system to slow down the sliding movement of the sliding hub 2.

Referring to figures 2a to 2f, the shape of the elongate troughs 12 have been altered so that they taper as can be seen in figure 6. This results in the trough narrowing as it travels away from the circlip. Similarly, the splines 16 formed on the sliding hub 4 have also been tapered as can be seen in figure 4. This results in the side of the splines 16 having to

travel against the wall of the tapered elongate troughs 12 against the rotational movement of the spindle 4 thus increasing the resistance between the two. Furthermore, the end 20 of the splines 16 adjacent the circlip has been tapered at an angle 26 relative to the longitudinal axis of the sliding hub as best seen in figure 4. This enables a rubber O-ring to be used to stop the sliding hub is opposed to a metal circlip 8.

Claims

1 A hammer comprising a spindle capable of being rotatingly driven by a motor via a drive chain, the drive chain comprising an overload spindle clutch which is capable of slipping when a torque which is greater than a predetermined amount is applied to it wherein the clutch comprises a sliding hub which is slidably mounted on the spindle having at least one spline formed along its inner surface which engages with a corresponding trough formed along the length of the spindle characterised in that the trough and the spline are correspondingly tapered along their length.

2 A hammer as claimed in claim 1 wherein the end of the spline adjacent a stop mechanism, which prevents the sliding hub from travelling rearwardly more than a predetermined position due to a biasing force, has been tapered at an angle relative to the longitudinal axis of the sliding hub.

3 A hammer as claimed in any of the previous claims wherein a rubber O-ring is mounted adjacent the end of the spline to prevent the sliding hub from travelling rearwardly more than a predetermined position due to a biasing force.

ABSTRACT

A hammer comprising a spindle capable of being rotatingly driven by a motor via a drive chain, the drive chain comprising an overload spindle clutch which is capable of slipping when a torque which is greater than a predetermined amount is applied to it wherein the clutch comprises a sliding hub which is slidably mounted on the spindle having at least one spline formed along its inner surface which engages with at least one corresponding trough formed along the length of the spindle characterised in that the trough and the splines are correspondingly tapered along their length. The end of the spline adjacent an O-ring, which prevents the sliding hub from travelling rearwardly more than a predetermined position due to a biasing force of a spring, has been tapered at an angle relative to the longitudinal axis of the sliding hub.

1/16

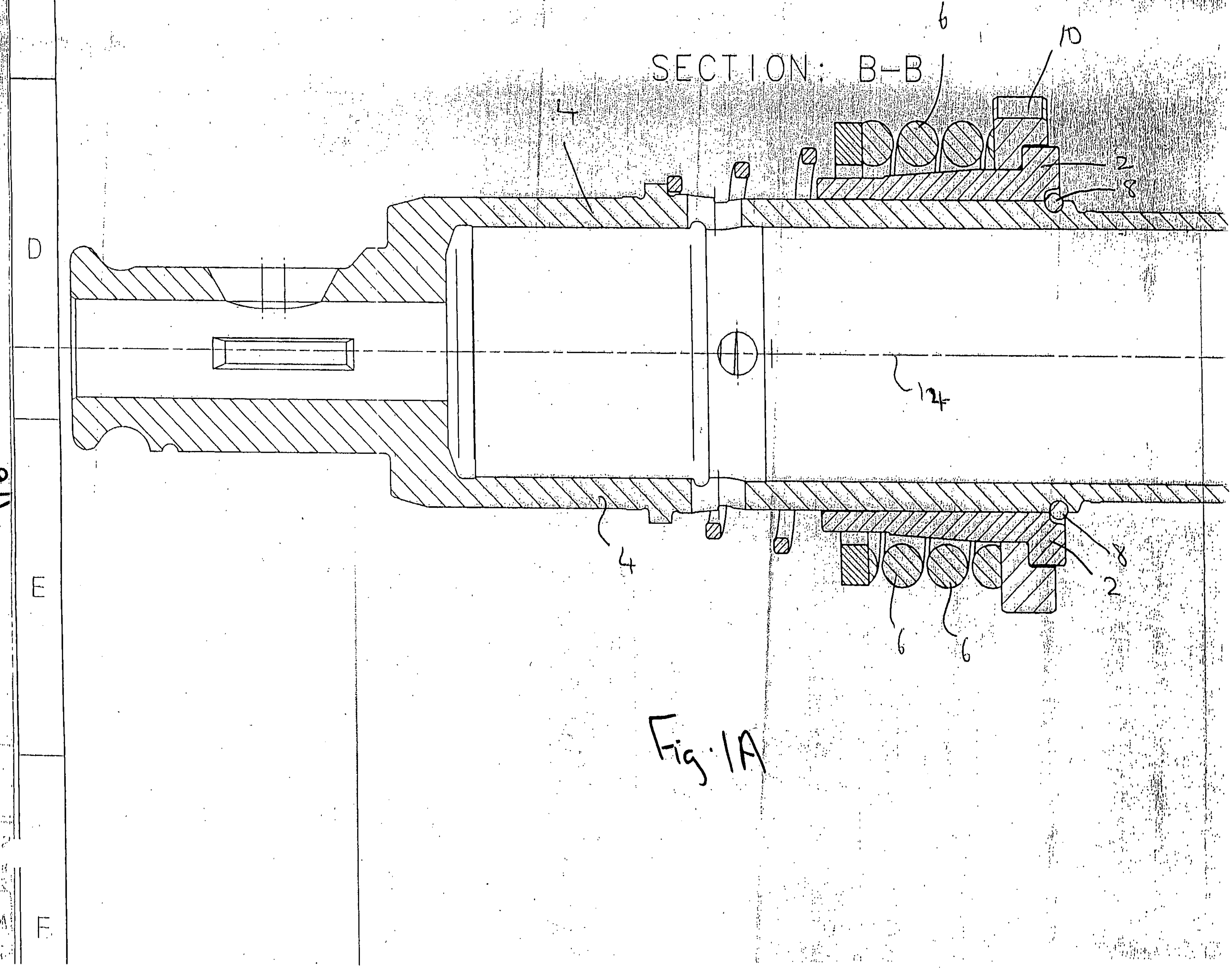

Fig. 1A

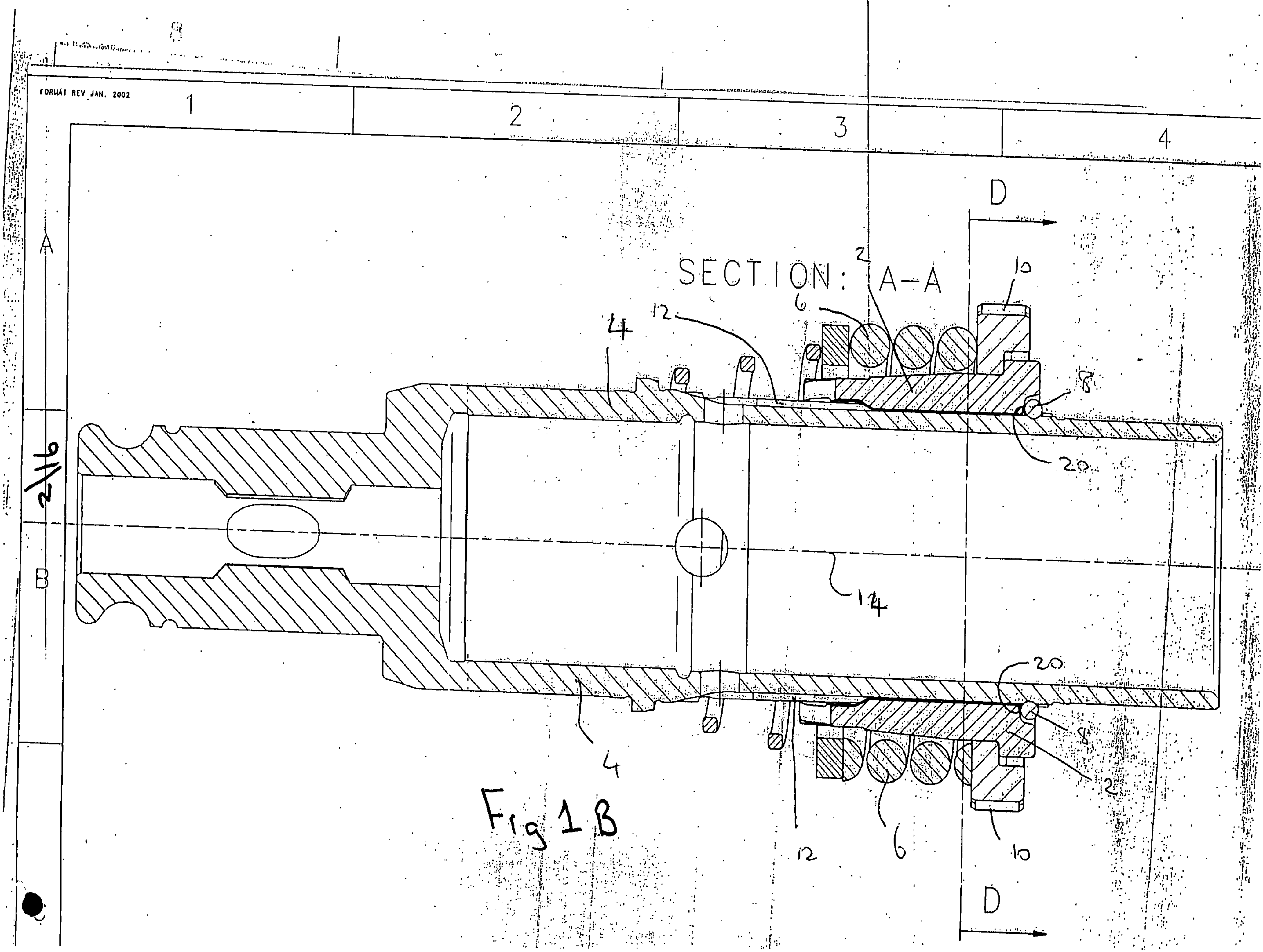
FORMAT REV JAN. 2002
1
2
3
4
A
B
SECTION: A-A
D
D
2
4
4
6
6
8
8
10
10
12
12
14
20
20

Fig 1B

SECTION: D-D

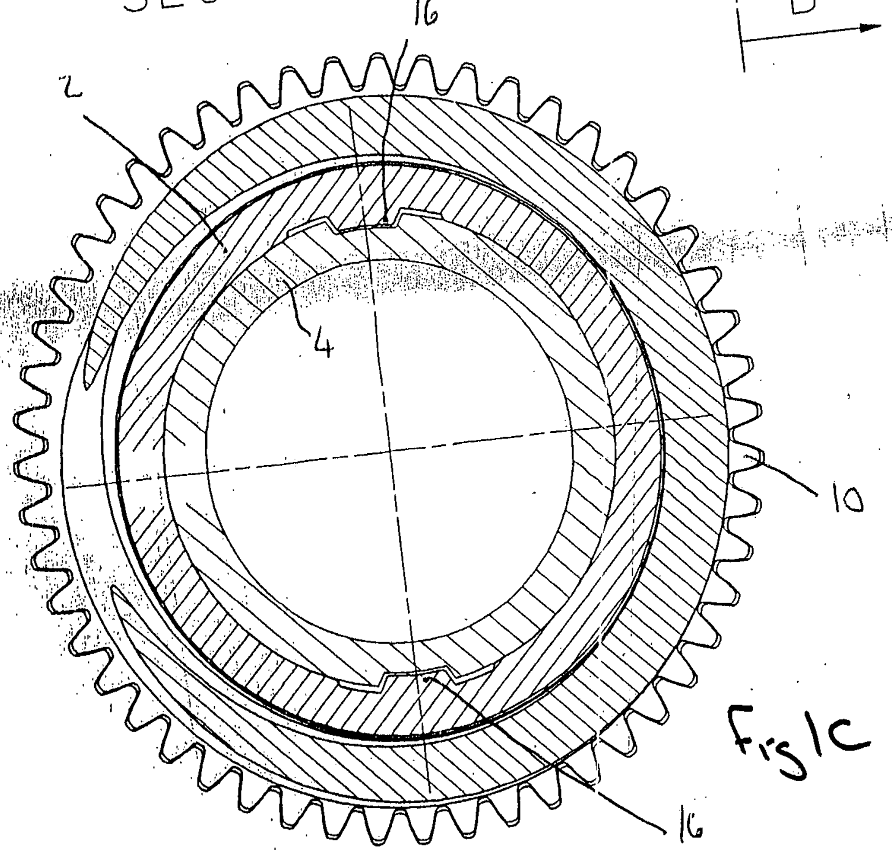

Fig 1C

SECTION: C-C

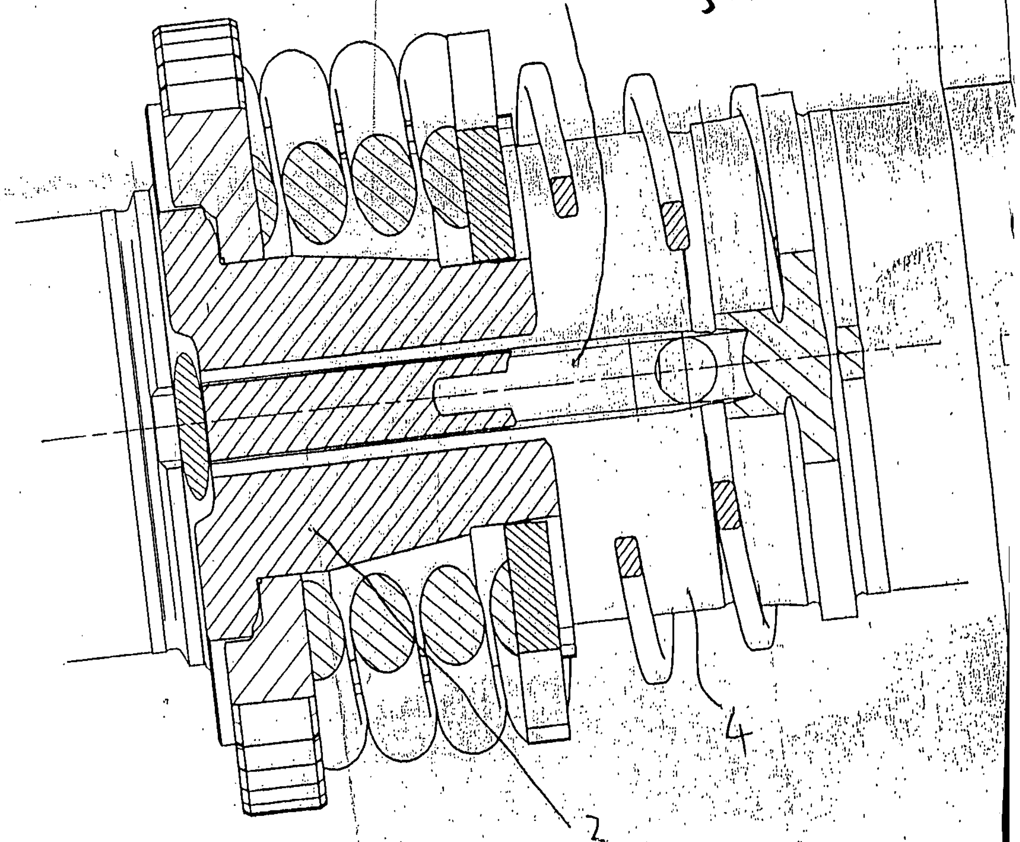

Fig 1D

4/16

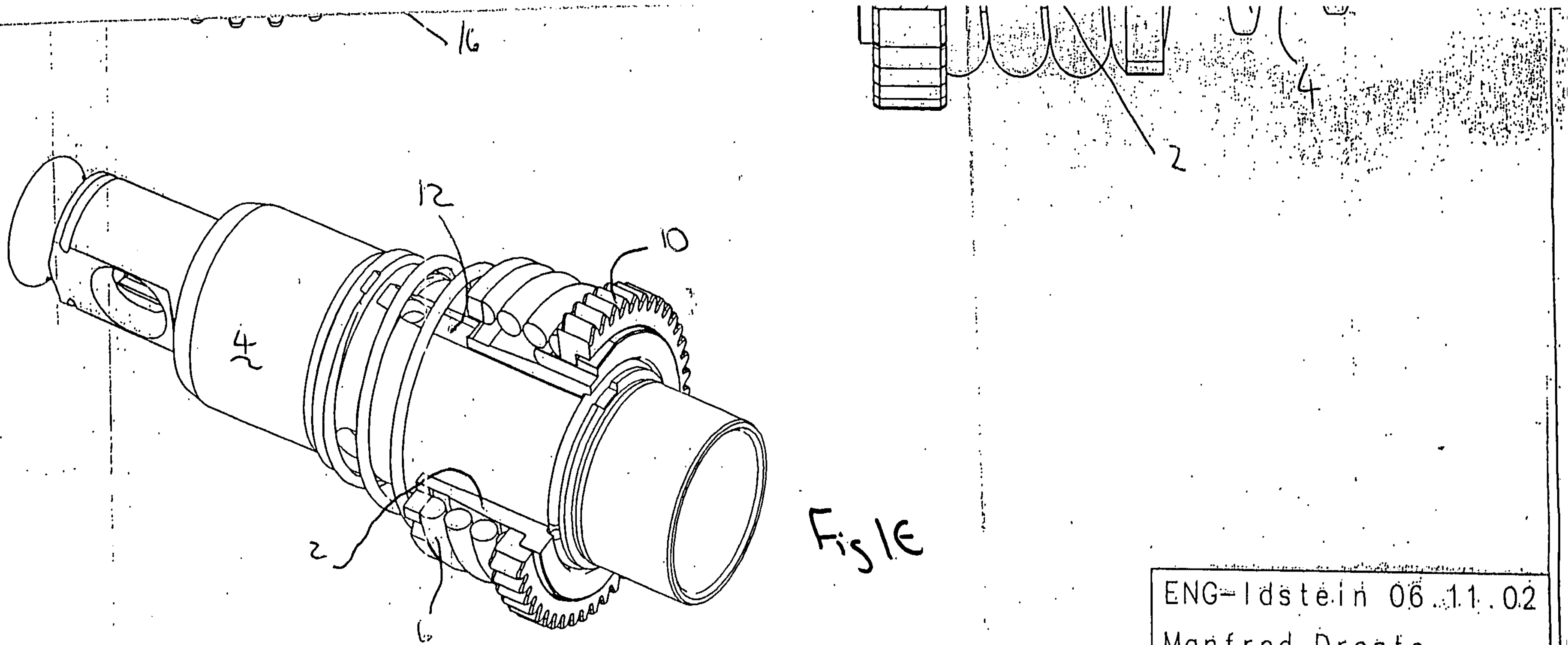

Fig 16

ENG-Idstein 06.11.02
Manfred Droste

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TOL UNLESS SPECIFIED	FOR ITEM DATA SEE PRINTED REPORT
	DOC NO:
ALL DIMENSIONS mm	REV: VERSION:
THIRD ANGLE PROJ	TITLE: SA-Spindle_Clutch_Parallel
	EC:
	SHEET: 1 OF 1

DEV

DOC SIZE: A2
SCALE: 2:1;1:1

5 6

5/16

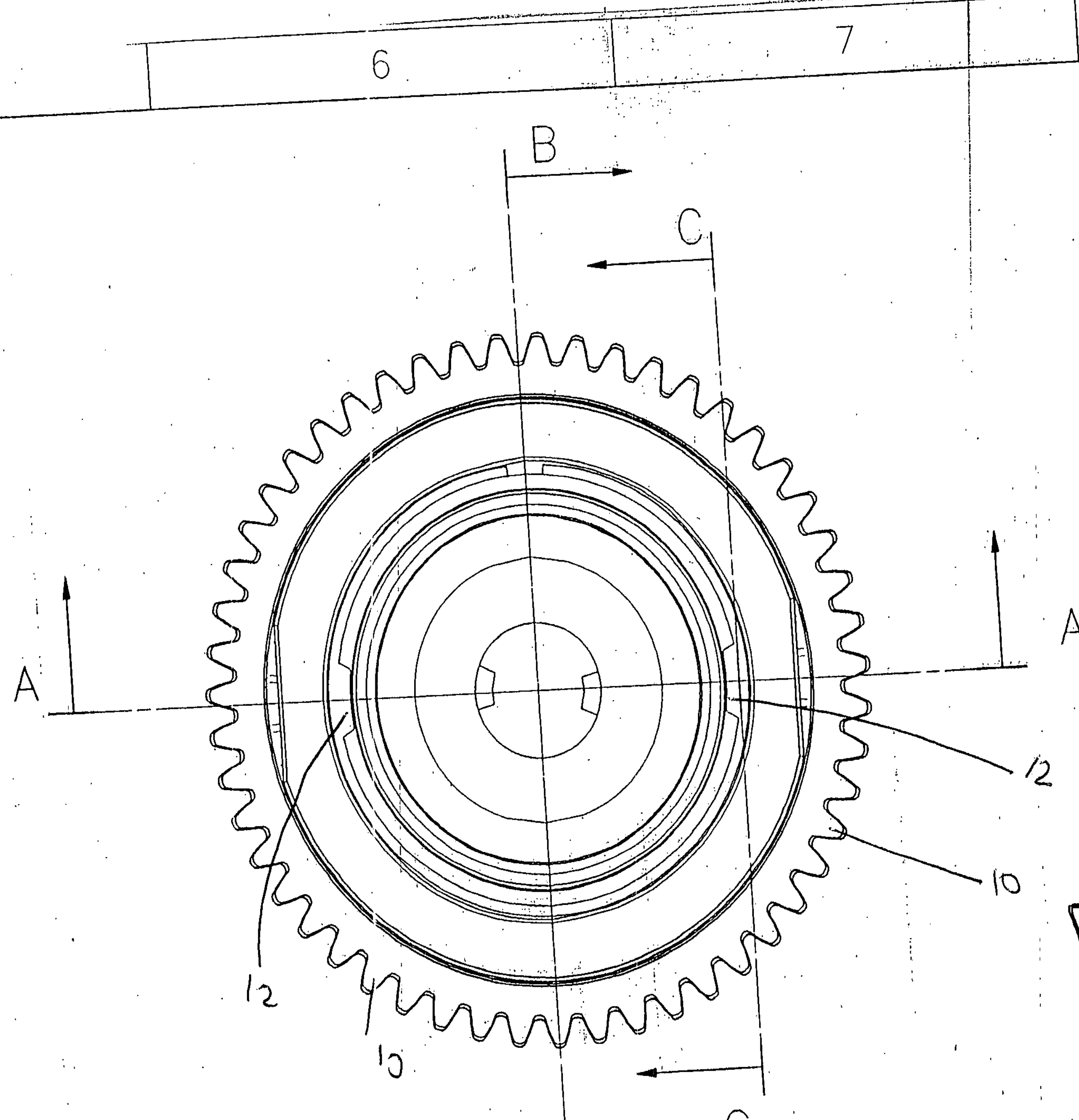

Fig. 1F

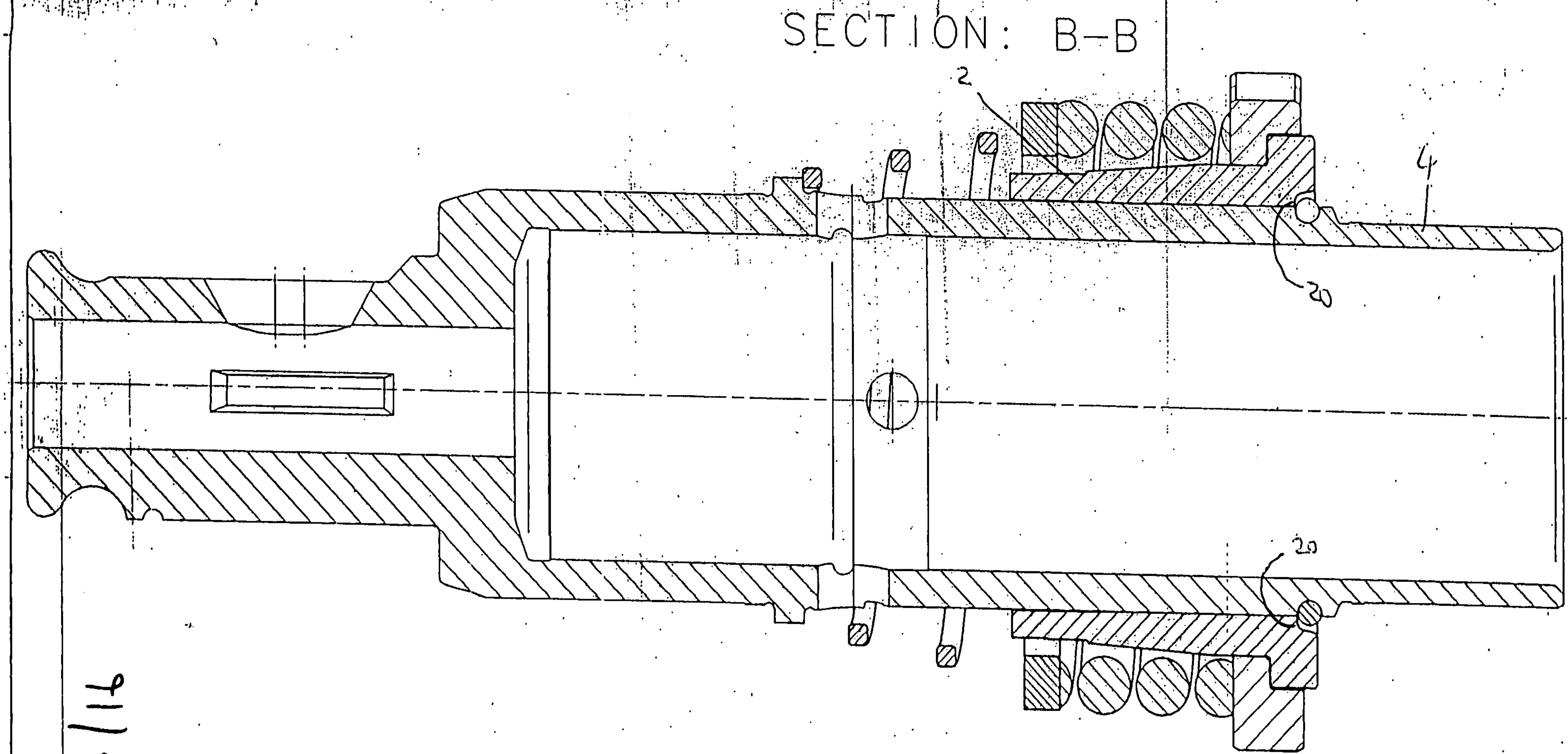

Fig. 2A

7/16

SECTION: A-A

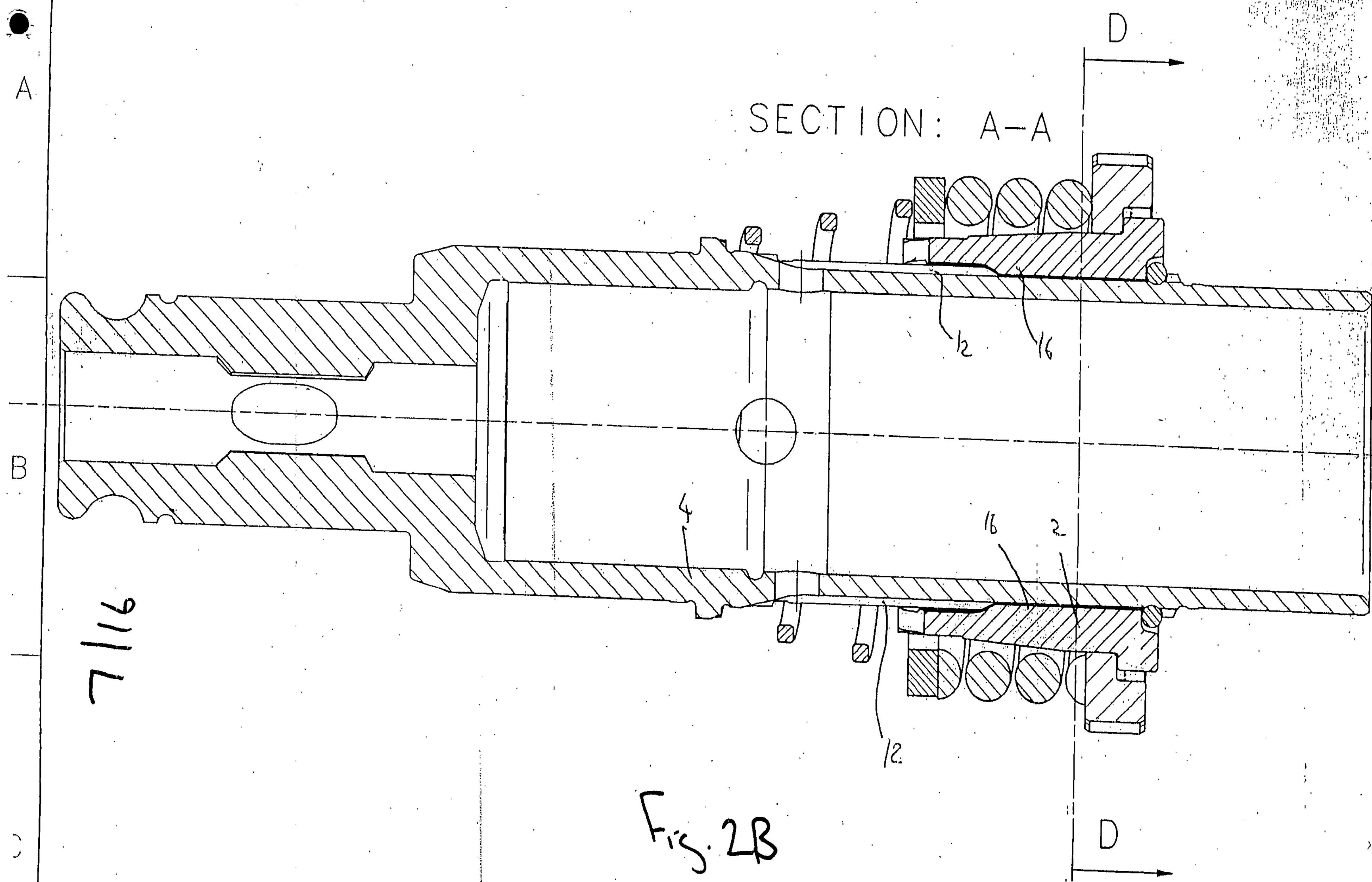

Fig. 2B

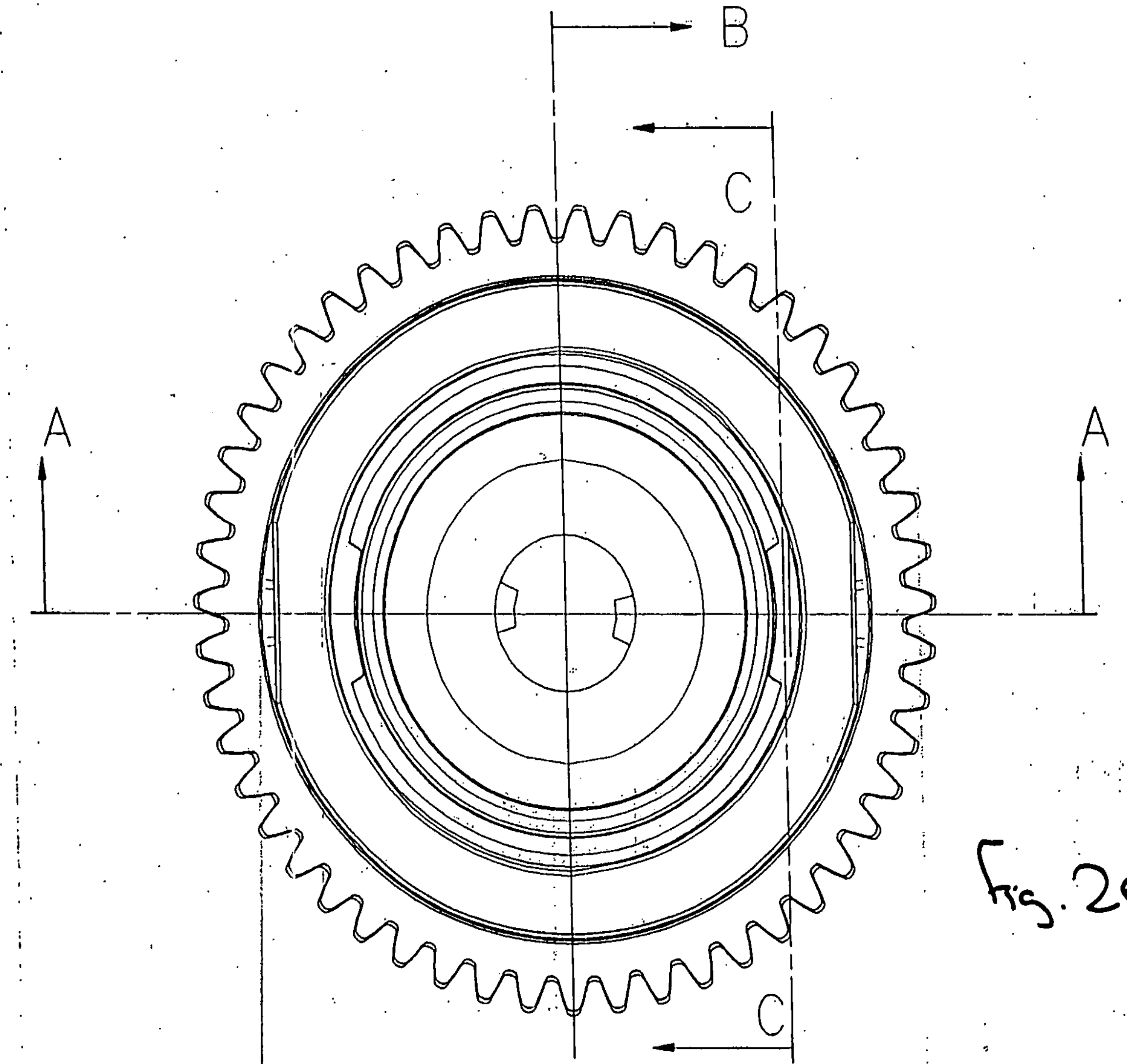

Fig. 2E

SECTION: C–C

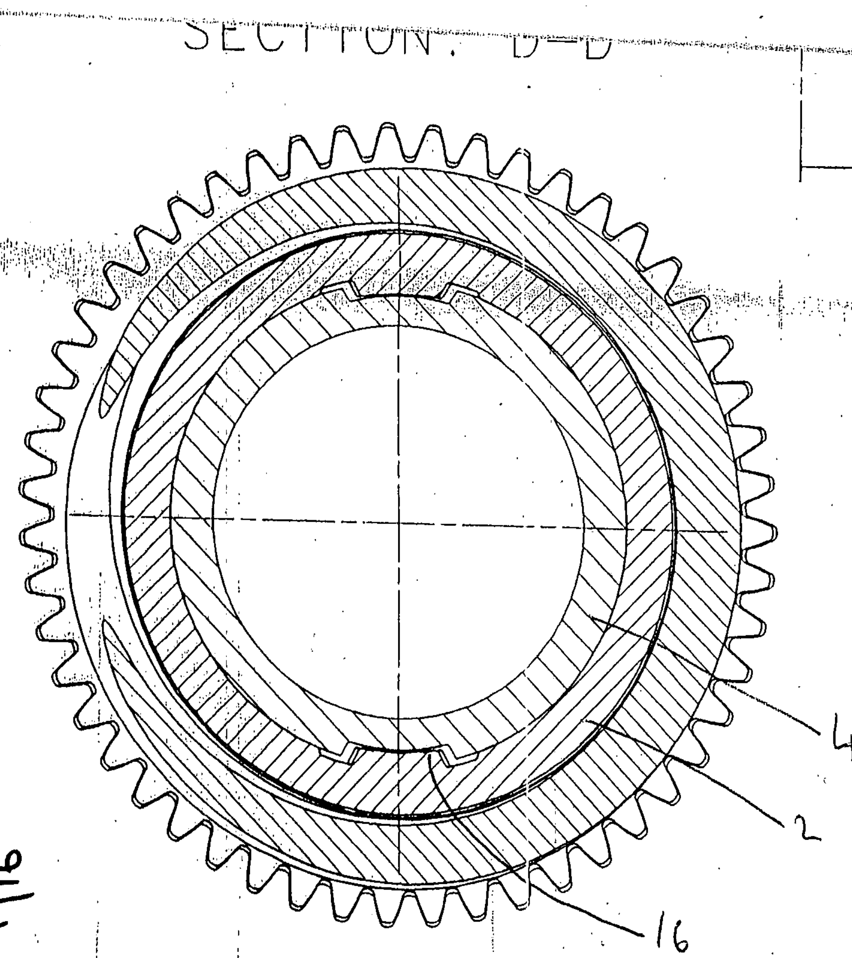

Fig. 2D

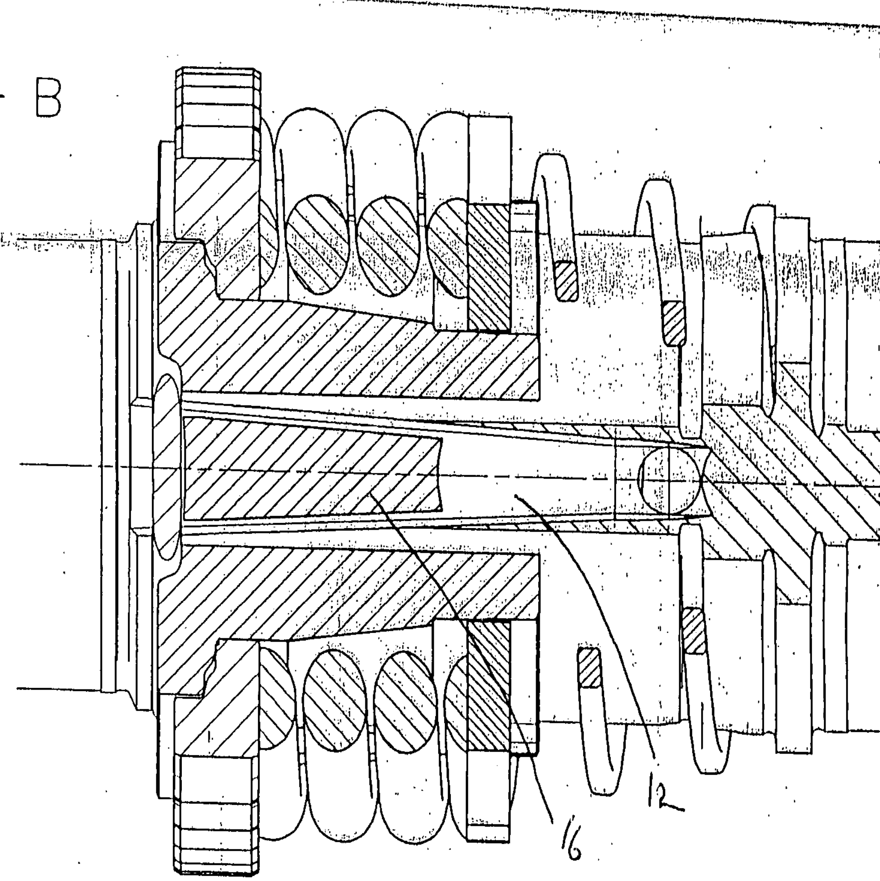

Fig. 2F

9/16

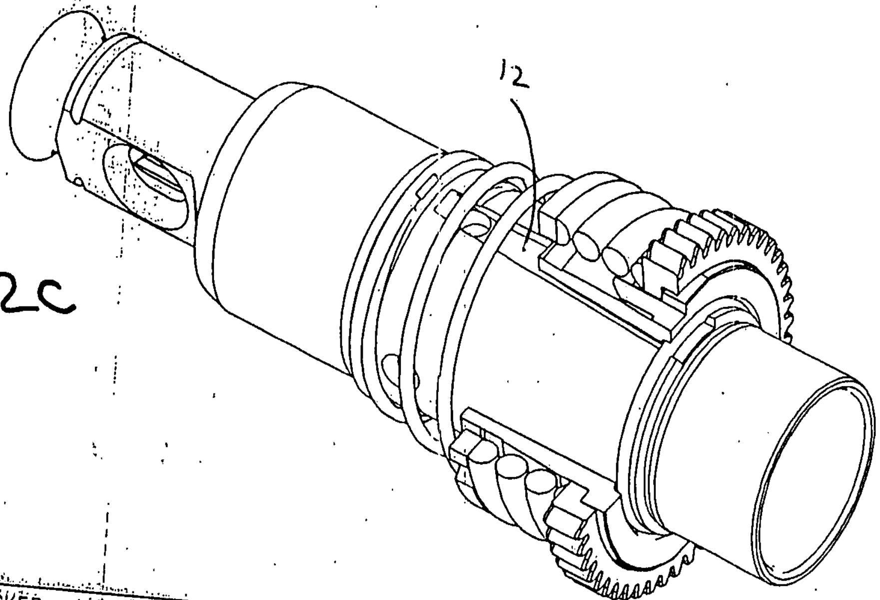

Fig 2c

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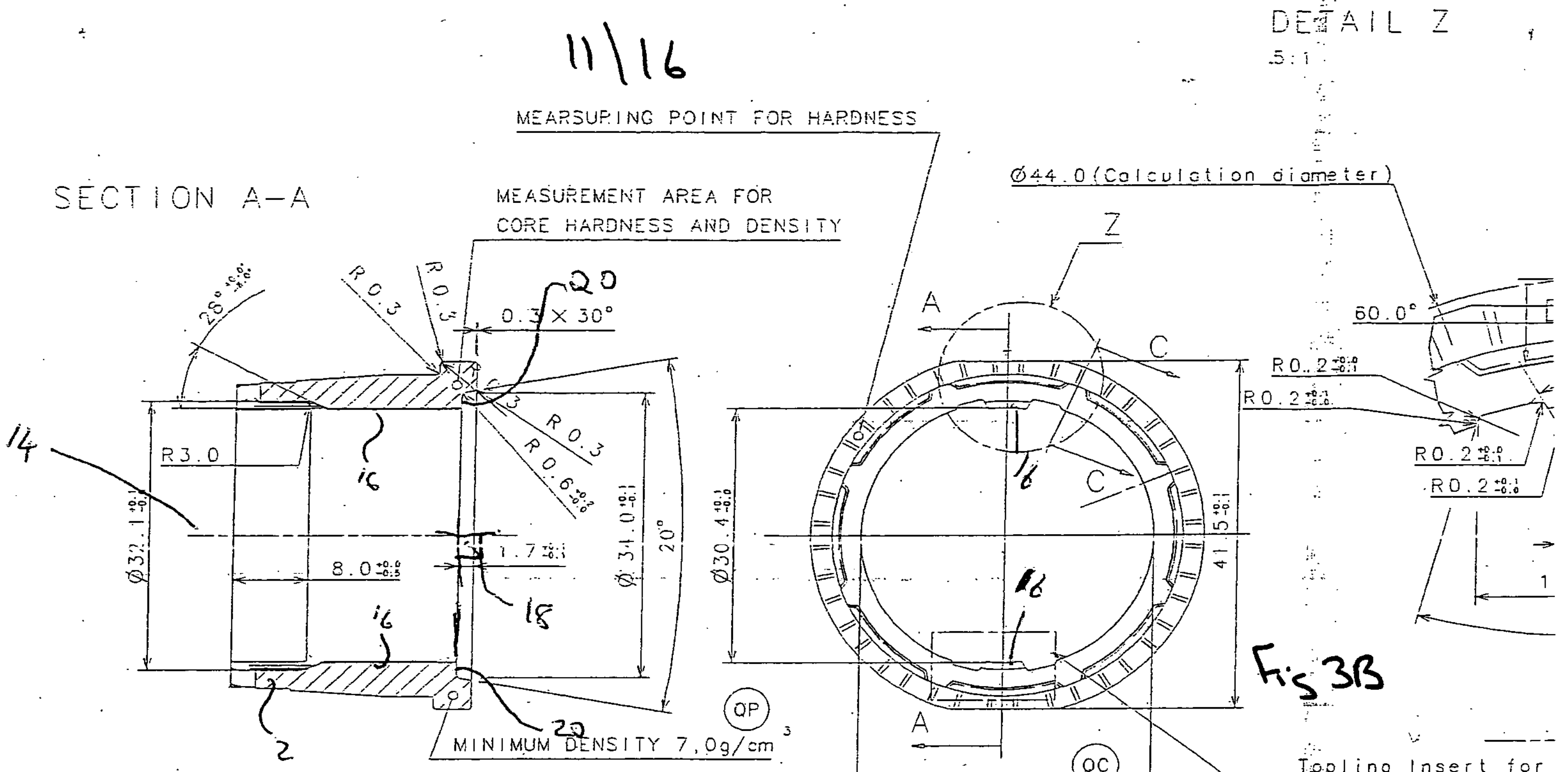

Fis 3A

ENERAL SPECIFICATIONS

1. Supplier: ______?______
2. Material: SINT D30 (70-DAE)
3. Weight: 76 g (Density 7,0 g/cm^3)
4. Materialdensity : 6,8 - 7,2 g/cm^3
5. All Dimension are valid after hardening
6. Not dimensioned Indexing error : 0,02
7. Edges deburred
8. Hordened by case hardening
   Apparent Hardness HV5 400-500 QP
   (according to DIN 30911 Part 4 paragraph 5.2)
   Case depth (according to DIN 30911 Part5)
   Eht 550 HV 0,2 = 0,2 + 0,3 QP
   Core hardness HV5 250-350 QP
. Conservation: HOUGHTO-OUENCH 279
   -------Film thickness max 3μ
. General Tolerance DIN ISO 2768 -mH-E
. . QC Denotes a critical dimension, which requires a Cpk 1.33 . in addition the process must be controlled by an appropriate control method i.e.: SPC, Gougiing
   QP Denotes features, which requires a frequent control according to the quality plan

Fis.3C

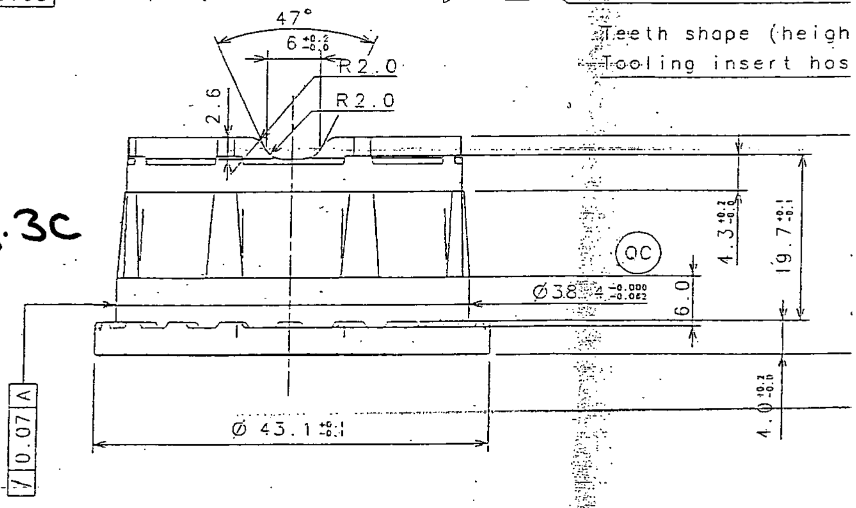

Fig.3

…2768-m General tolerances	Values in millimetres	
…near Dimensions	Angular Dimensions	radii and chamfer
0.5 up to 6 ±0.1	up to 10 ±1°	0.5 up to 3 ±0.2
6 up to 30 ±0.2	over 10 up to 50 ±0°30'	over 3 up to 6 ±0.5
30 up to 120 ±0.3	over 50 up to 120 ±0°20'	over 6 ±1
120 up to 400 ±0.5	over 120 up to 400 ±0°10'	

…r nominal sizes below 0.5 mm, the deviations shall be indicated …jacent to the relevant nominal size(s).

+0.3 −0.0   +0.0 −0.3

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2 3 4 5

12\16

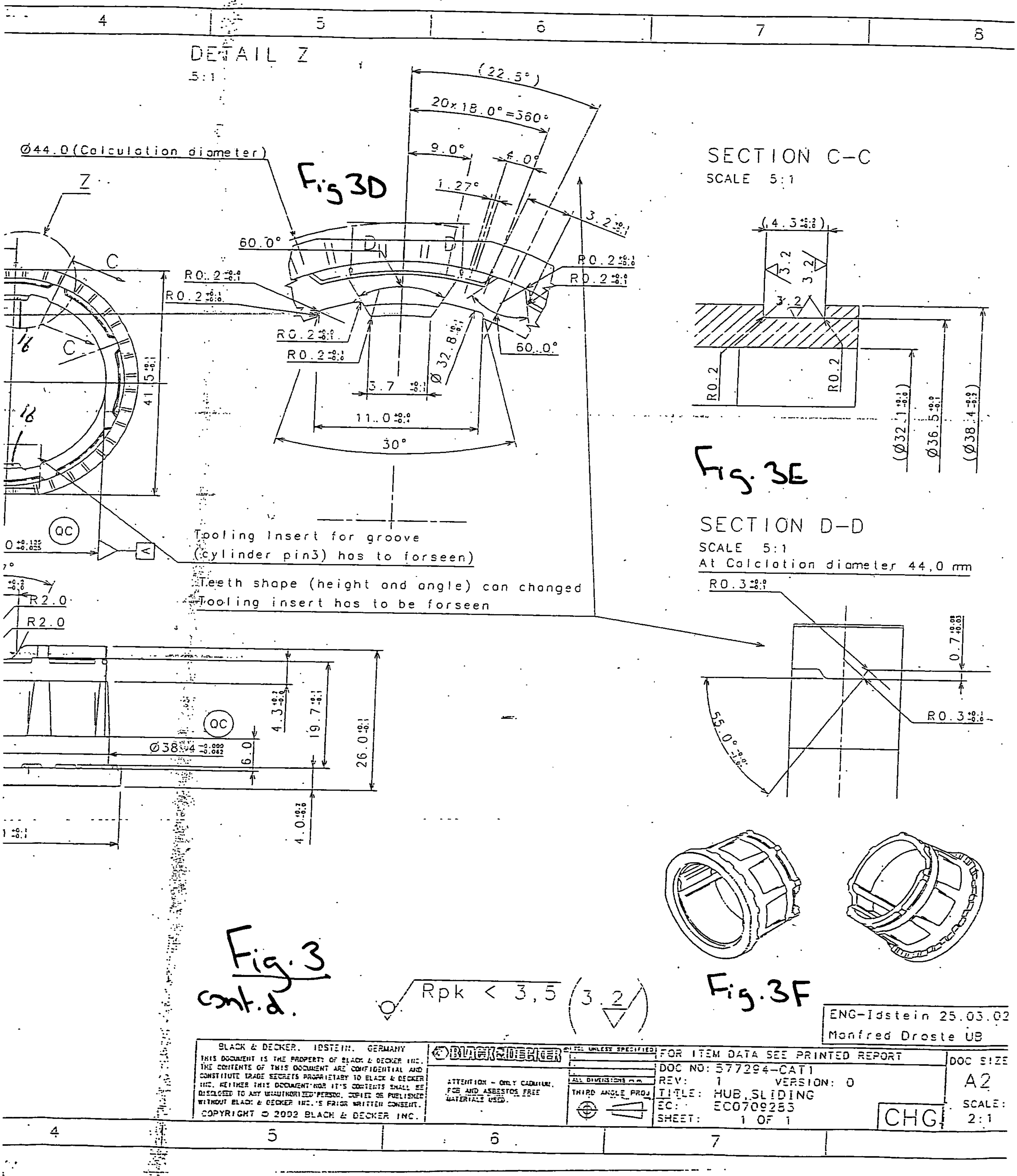
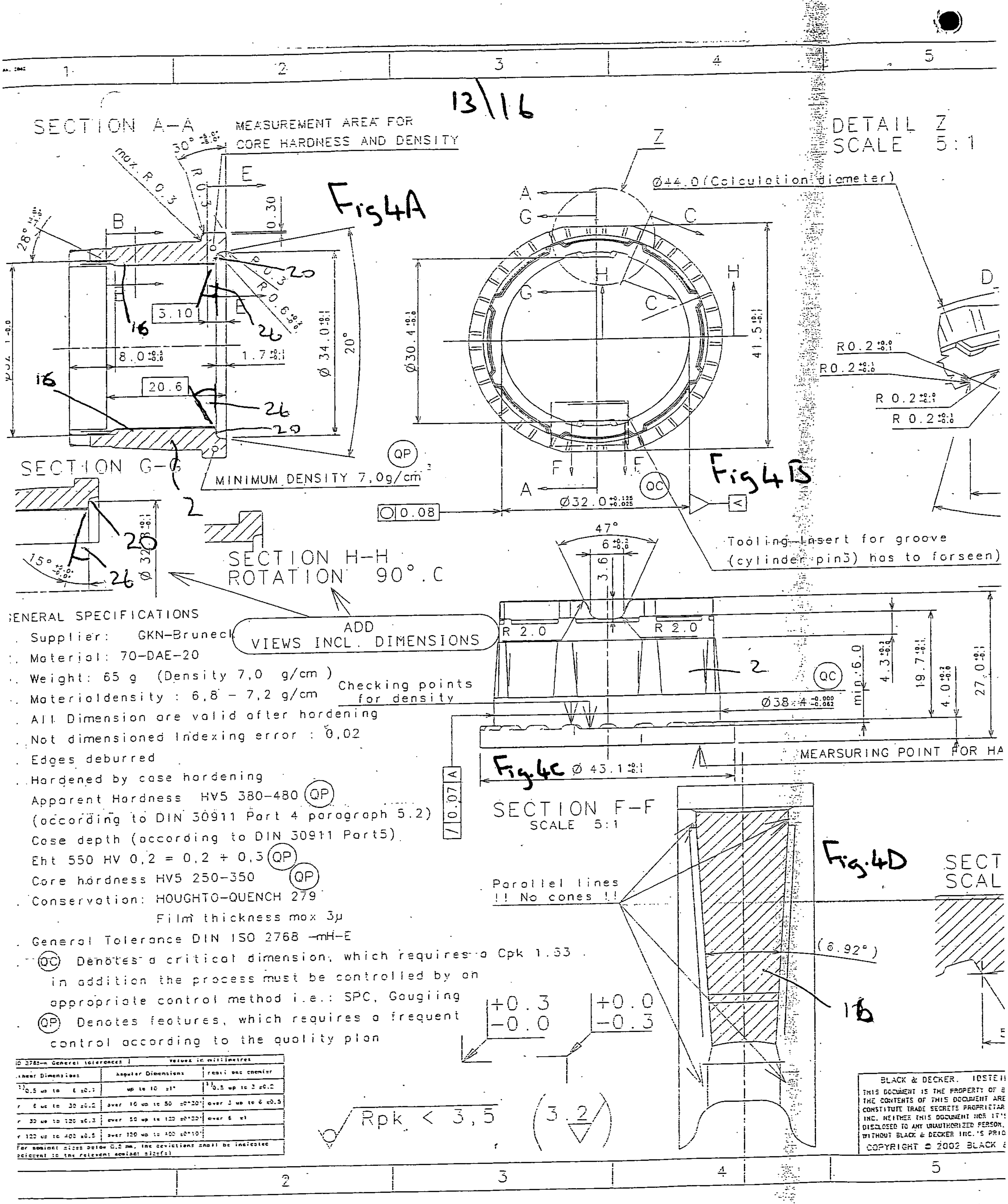


Fig 3D

Fig. 3E

Fig. 3F

Fig. 3 cont.d.



SECTION A-A
MEASUREMENT AREA FOR CORE HARDNESS AND DENSITY
Fig4A
DETAIL Z
SCALE 5:1
Ø44.0(Calculation diameter)
Fig4B
MINIMUM DENSITY 7,0g/cm³
SECTION G-G
SECTION H-H
ROTATION 90°.C
ADD VIEWS INCL. DIMENSIONS
Tooling insert for groove (cylinder pin3) has to forseen)
GENERAL SPECIFICATIONS
Supplier: GKN-Bruneck
Material: 70-DAE-20
Weight: 65 g (Density 7,0 g/cm)
Materialdensity : 6,8 - 7,2 g/cm
All Dimension are valid after hardening
Not dimensioned Indexing error : 0,02
Edges deburred
Hardened by case hardening
Apparent Hardness HV5 380-480 (QP)
(according to DIN 30911 Part 4 paragraph 5.2)
Case depth (according to DIN 30911 Part5)
Eht 550 HV 0,2 = 0,2 ÷ 0,3 (QP)
Core hardness HV5 250-350 (QP)
Conservation: HOUGHTO-QUENCH 279
Film thickness max 3μ
General Tolerance DIN ISO 2768 -mH-E
(QC) Denotes a critical dimension, which requires a Cpk 1.33 in addition the process must be controlled by an appropriate control method i.e.: SPC, Gougiing
(QP) Denotes features, which requires a frequent control according to the quality plan
Checking points for density
MEARSURING POINT FOR HA
Fig.4C
SECTION F-F
SCALE 5:1
Fig.4D
Parallel lines
!! No cones !!
Rpk < 3,5
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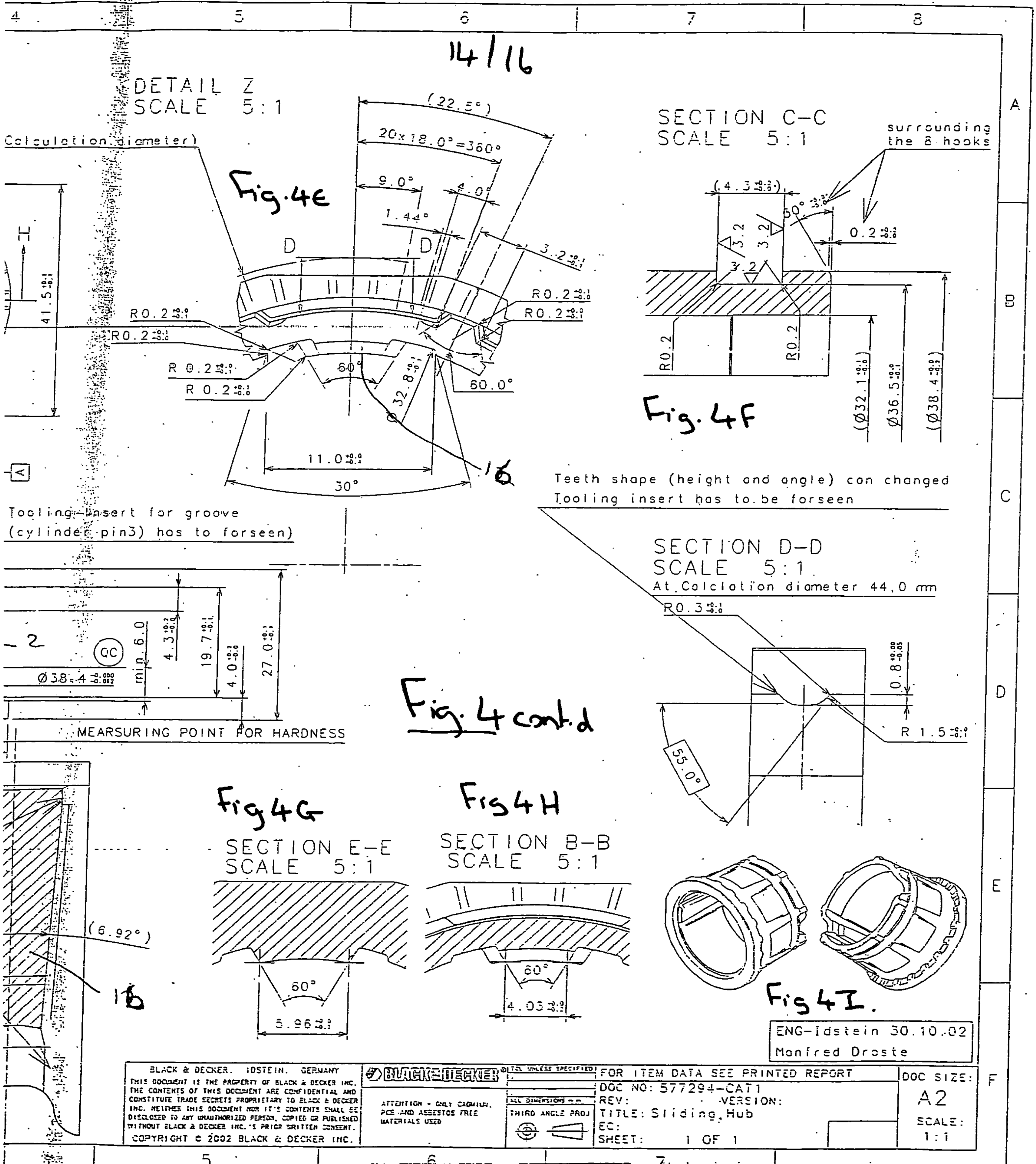
Fig. 4


DETAIL Z
SCALE 5:1
Calculation diameter)
Fig. 4E
(22.5°)
20x18.0°=360°
9.0°
4.0°
1.44°
D
D
3.2
R0.2
R0.2
R0.2
R0.2
R0.2
R0.2
60°
32.8
60.0°
11.0
30°
16
41.5
H
A
Tooling insert for groove
(cylinder pin3) has to forseen)
SECTION C-C
SCALE 5:1
surrounding
the 8 hooks
(4.3)
30°
0.2
3.2
3.2
3.2
R0.2
R0.2
(Ø32.1)
Ø36.5
(Ø38.4)
Fig. 4F
Teeth shape (height and angle) can changed
Tooling insert has to be forseen
SECTION D-D
SCALE 5:1
At Calclation diameter 44,0 mm
R0.3
0.8
R 1.5
55.0°
2
QC
Ø38.4
min.6.0
4.3
19.7
4.0
27.0
MEARSURING POINT FOR HARDNESS
Fig. 4 cont.d
(6.92°)
16
Fig 4G
SECTION E-E
SCALE 5:1
60°
5.96
Fig 4H
SECTION B-B
SCALE 5:1
60°
4.03
Fig 4I.
ENG-Idstein 30.10.02
Manfred Droste
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DOC NO: 577294-CAT1
REV: VERSION:
TITLE: Sliding Hub
EC:
SHEET: 1 OF 1
DOC SIZE: A2
SCALE: 1:1

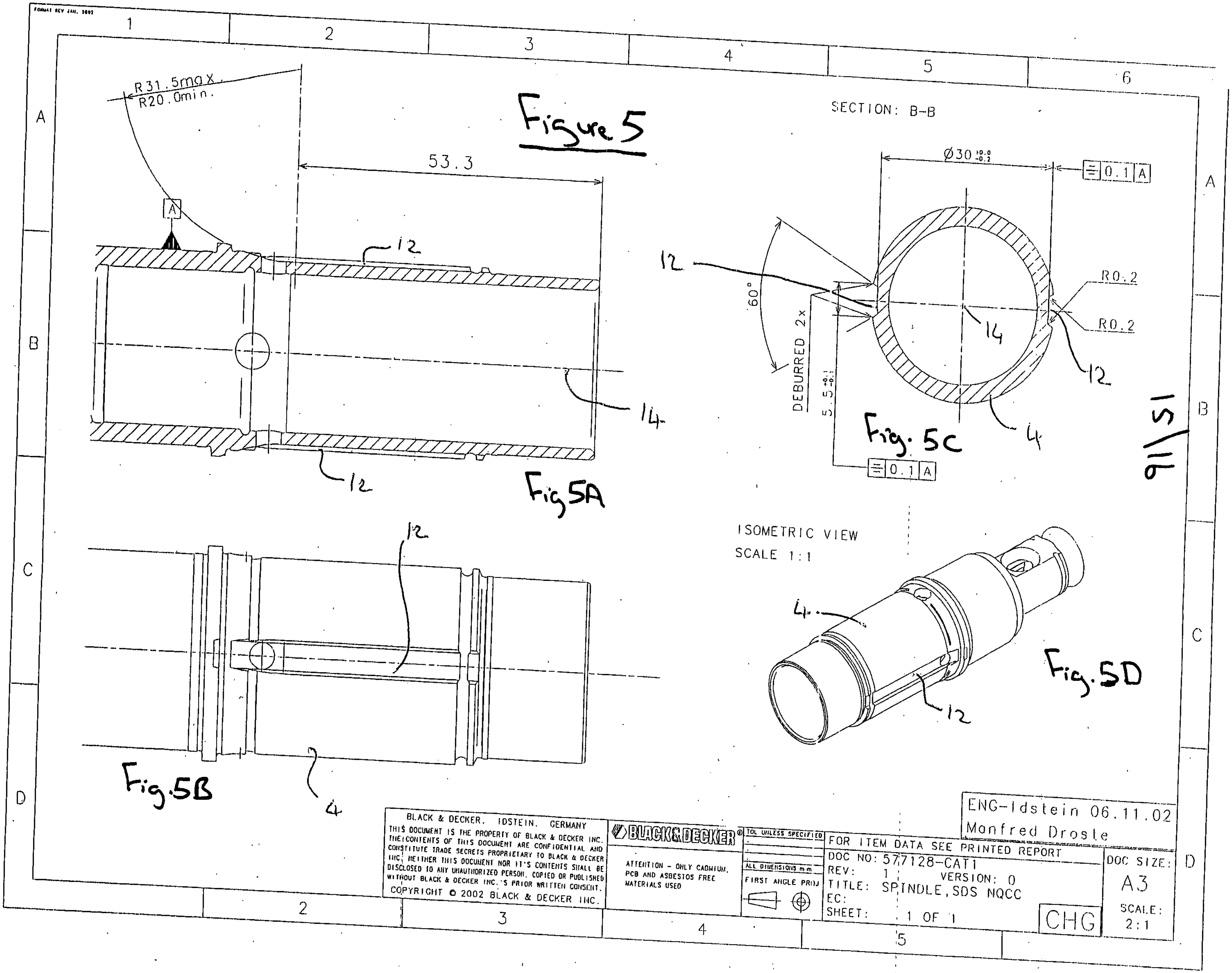
Figure 5
R31.5max.
R20.0min.
A
53.3
12
12
14
Fig5A
12
4
Fig.5B
SECTION: B-B
Ø30 +0.0 -0.2
0.1 A
60°
DEBURRED 2x
5.5 +0.1 -0.1
R0.2
R0.2
12
14
12
4
Fig. 5C
0.1 A
ISOMETRIC VIEW
SCALE 1:1
4
12
Fig.5D
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DOC NO: 577128-CAT1
REV: 1 VERSION: 0
TITLE: SPINDLE, SDS NQCC
EC:
SHEET: 1 OF 1
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DOC SIZE: A3
SCALE: 2:1

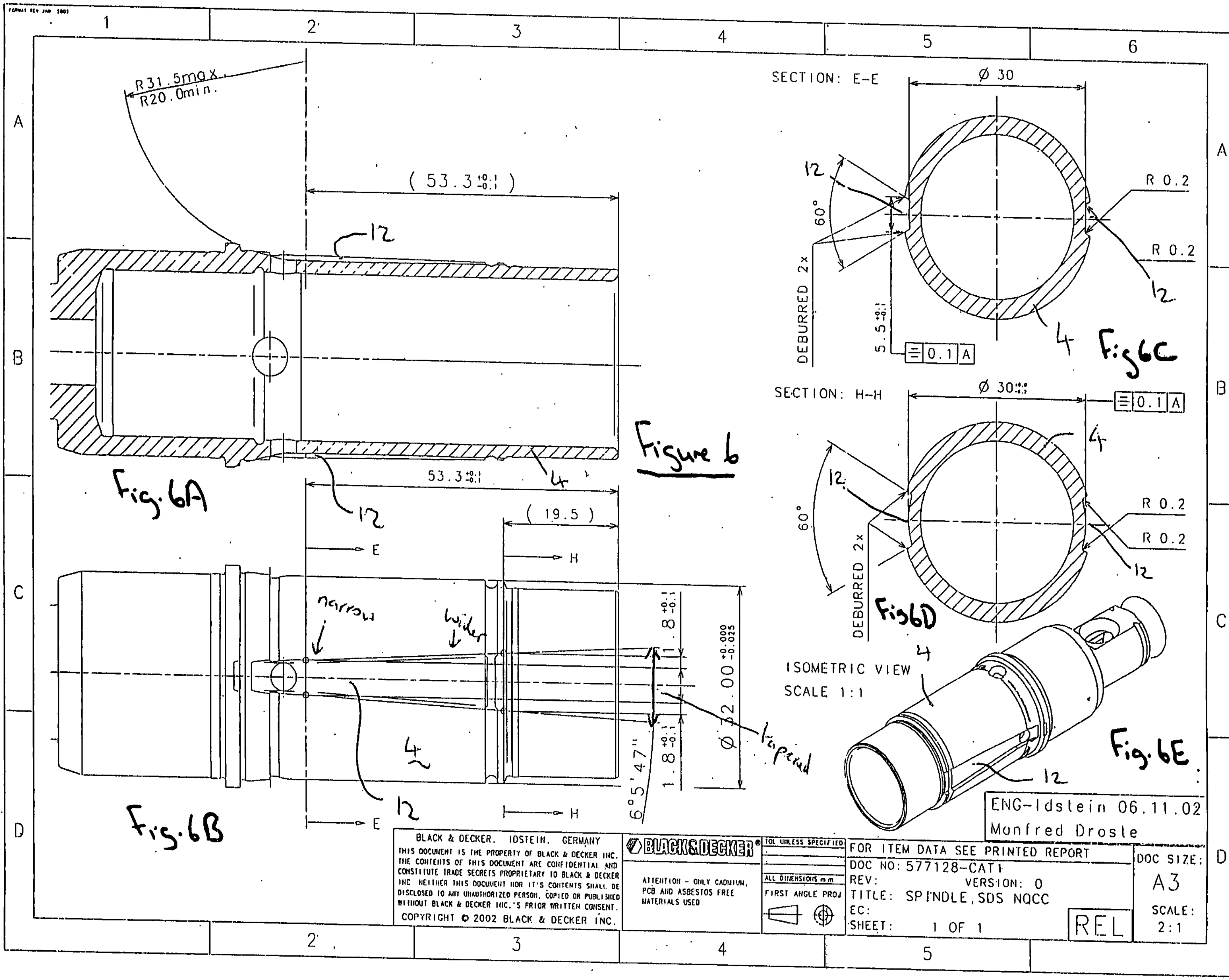
Figure 6
Fig. 6A
Fig. 6B
Fig 6C
Fig 6D
Fig. 6E
R31.5max.
R20.0min.
(53.3 +0.1 -0.1)
53.3 +0.1 -0.1
(19.5)
E
H
narrow
wider
tapered
12
4
6°5'47"
1.8 +0.1 -0.1
Ø 32.00 +0.000 -0.025
SECTION: E-E
SECTION: H-H
Ø 30
R 0.2
60°
DEBURRED 2x
5.5 +0.1 -0.1
0.1 A
ISOMETRIC VIEW
SCALE 1:1
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